



Adelaide Urban Heat and Tree Canopy Mapping Project

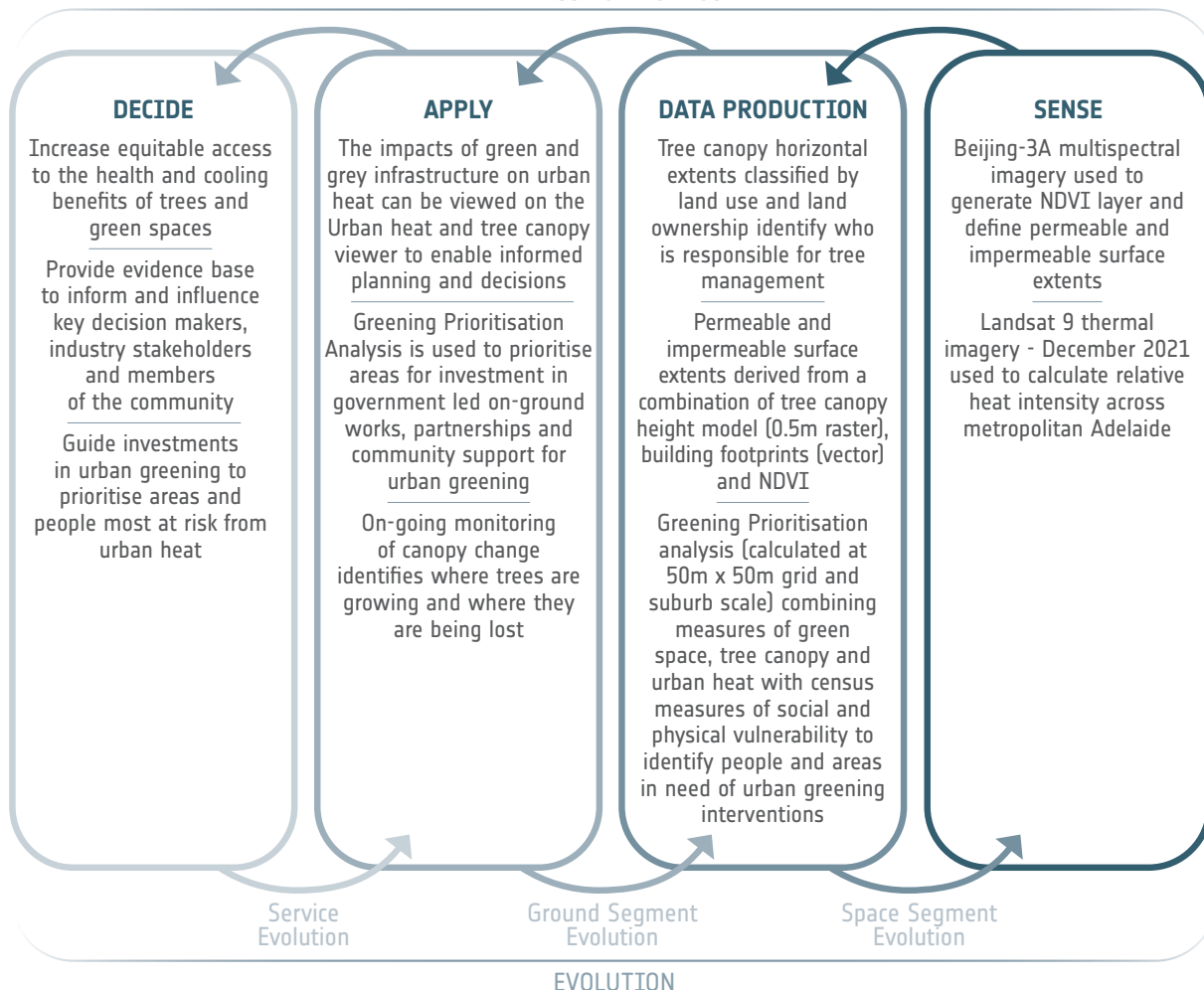
Summary

In a changing climate, cities are experiencing the extremes of urban heat through longer and more intense heat waves. The impacts of heatwaves are exacerbated by the “Urban Heat Island effect” (UHI) where high proportions of built or grey infrastructure in cities increase the temperatures experienced, especially at night. The artificial (impermeable) surfaces absorb heat during the day and re-emit it to the local

environment long after sunset. Globally, UHI is known to disproportionately impact people from culturally and linguistically diverse backgrounds, people of lower socio-economic status, younger children (<5 years old), older people (>65 years old), and people with chronic health or mental health conditions. These are the people who are less likely to have the adaptive capacity or the physical resilience to cope with urban heat. They may be living alone, or in high density or low quality housing. Trees and other healthy

Value Chain Diagram

FITNESS FOR PURPOSE



green infrastructure are known as 'nature's air-conditioners' and help to cool their surrounds through shading and evapotranspiration and can provide up to 10°C cooling.

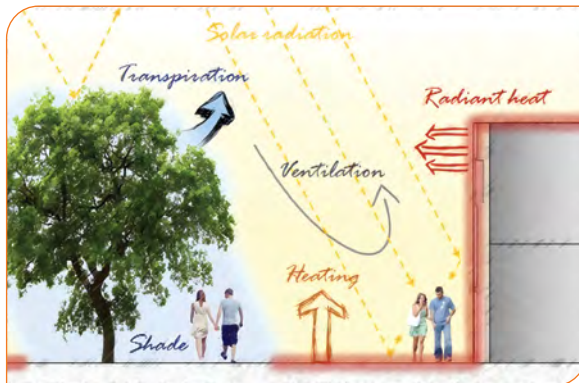


Fig. 1 Schematic illustration of the urban heat island effect and the cooling role of urban vegetation (Attribution: CRC for Water Sensitive Cities)

Between 2016 and 2019, groups of metropolitan Adelaide councils collaborated on a number of projects to map urban heat and tree canopy. Green Adelaide led a project in 2022 working with metropolitan councils to apply the

methodology of the proceeding projects and, for the first time, map urban heat and tree canopy data across the entire metropolitan Adelaide region in a single contiguous dataset. The project combined satellite and aerial platform data sources. LiDAR and thermal imagery were captured from aerial platforms and multispectral imagery was captured using the Beijing-3A satellite. LiDAR data was processed to measure the 3-dimensional extents of tree canopy and built structures. Multispectral imagery was used to generate a Normalised Differential Vegetation Index (NDVI) layer. LiDAR and NDVI data were combined to generate a spatial layer defining the extents of permeable and impermeable surfaces. Using this data, Green Adelaide and project partners have a powerful evidence base to identify areas and members of the community that are most impacted by UHI.

In order to prioritise areas most in need of urban greening interventions, Landsat heat intensity data was combined with environmental variables



Fig. 2 Tree canopy height data

from LiDAR and NDVI and national census measures of social and physical vulnerability to produce a Greening Prioritisation Analysis. This analysis is used by Green Adelaide and partners to prioritise areas for on-ground urban greening works or community interventions through grants or education.

Decision-Making Context and Needs

In a changing climate, the impacts of increasingly severe and more frequent heat waves are magnified in cities due to the Urban Heat Island (UHI) effect where cooler trees and green spaces have been replaced by artificial (impermeable) surfaces which act as heat sinks. Australian cities are particularly vulnerable as warming has occurred above the global average. Heatwaves are now ranked as the most significant natural hazard in Australia and are linked to an increase in mortality. Heat waves globally disproportionately impact communities of lower socioeconomic status as they are less able to

escape or mitigate the impacts due to a range of factors including poor or high-density housing, cost of air-conditioning, working in manual or outdoor jobs or language barriers inhibiting access to support and health services.

Green infrastructure including trees and other healthy vegetation are known to provide cooling and other health benefits such as pollution reduction to their local areas. As the need for higher density housing increases, green infrastructure is often in conflict with development and many large trees across metropolitan Adelaide are being lost. Equitable access to trees and green spaces in areas of high density housing or low socioeconomic neighbourhoods has the potential to provide a range of physical and mental health benefits through fostering greater connections with nature, encouraging physical activity, reducing pollution as well as cooling and shading.

Green Adelaide, in partnership with South Australian state government and local metropolitan councils have established the urban heat and tree canopy mapping project using a combination of satellite and aerial based remote sensing. The data describes the extents and interactions between tree canopy, built infrastructure and UHI. These environmental data were combined with census measures of socioeconomic status and chronic health to provide a robust evidence base to guide investment and on-ground urban greening actions which aim to mitigate urban heat for the most vulnerable people in our community.

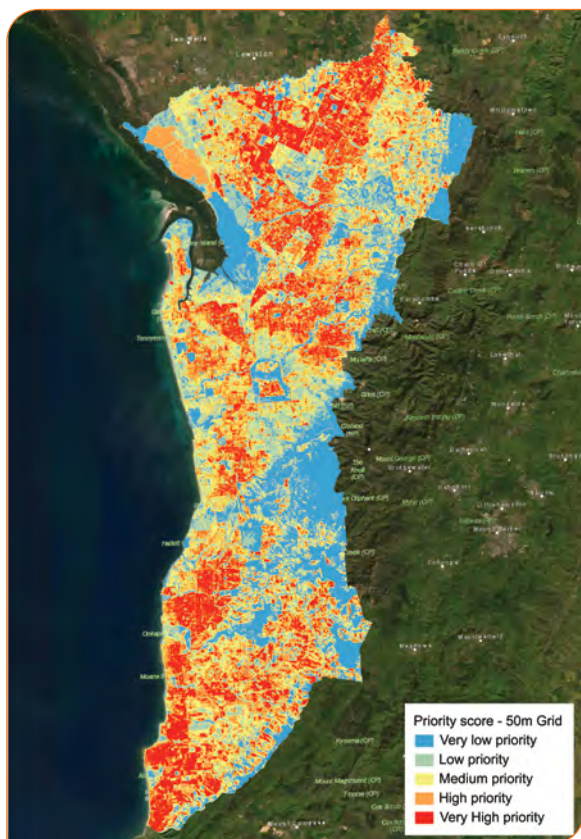


Fig. 3 Greening Prioritisation Analysis data

Earth Observation Data Products and Information

Data from a range of remote sensing platforms have been used to build a comprehensive evidence base to understand the drivers of urban heat across metropolitan Adelaide, identify the areas and communities who are most at risk and who are already feeling the impacts, drive investment in urban greening to target those most in need and then monitor changes over time.



Fig. 4 Adelaide's permeable and impermeable surface

Data describing tree canopy, green spaces and the built environment were captured using a combination of aerial LiDAR and satellite-based multispectral imagery from the Beijing-3A satellite. A Normalised Difference Vegetation Index (NDVI) was derived from the multispectral imagery and was combined with LiDAR data to identify the extents of permeable and impermeable surfaces. High resolution (2m) aerial thermal imagery provided valuable insights to the heat impacts of different surface types, trees and green spaces. These layers have been shared publicly in an interactive map to engage with the community and support individual landholder choices.

Future actions and investments will be guided by the Greening Prioritisation Analysis (GPA). This analysis brings together environmental data describing tree canopy, green spaces and built infrastructure extents with census measures of social vulnerability and chronic health and Landsat urban heat intensity imagery. The

analysis was calculated at suburb scale and at 50m x 50m grid to provide landscape scale guidance of policies and government strategies as well as target on-ground work at the street and neighbourhood scale. This analysis identifies the areas most in need to increase equitable access to the benefits of urban green infrastructure.

Underlying Observations and Data Sources

The project uses a variety of satellite and aerial based sensor platforms to provide a detailed picture of metropolitan Adelaide's urban forest, built infrastructure and how they interact to drive urban heat.

- Classified LiDAR (12ppm) - for derived tree canopy height model, tree canopy horizontal and built infrastructure extents (0.5m resolution)

- Aerial thermal imagery - 2m spatial resolution for day-time and night-time capture. Used for identification of urban heat islands (125m x 125m areas > 2°C above mean local temperature), identification of thermal properties of different surface types and colours (ie. different coloured roofing, roads, irrigated vs non irrigated lawns etc)
- Beijing-3A multispectral (NIR) imagery - 2m native resolution, panchromatic 0.5m resolution GSD used to generate Normalised Differential Vegetation Index (NDVI) to identify areas of actively growing vegetation. This was combined with LiDAR data to identify extents of permeable (natural) and impermeable (artificial) surfaces.
- Landsat satellite thermal imagery sampled at 30m resolution. Represented as an urban heat intensity value which measures the amount of heat in the landscape associated with urban development, when compared against a natural analogue.
- A Greening Prioritisation Analysis (GPA) was undertaken to identify areas of high priority for urban greening to support heat mitigation. The GPA combines environmental variables of tree canopy, green space and built infrastructure extents, urban heat intensity and census variables of socioeconomic status, and chronic health.

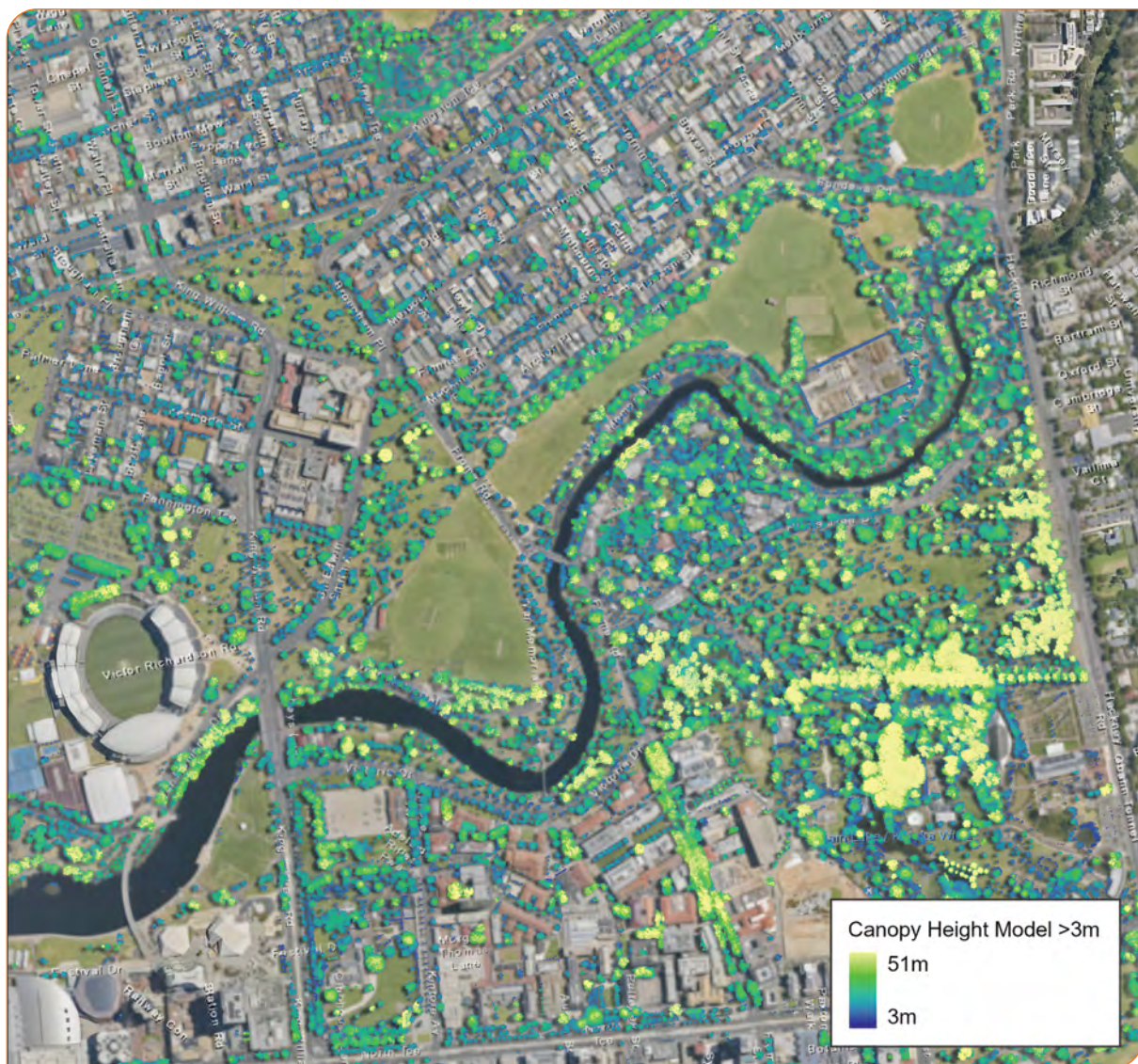


Fig. 5 Tree canopy height model of Adelaide

Impacts and Benefits

State government:

- Using the data to guide investments in on-ground works and social interventions such as environmental stewardship educational programs and prioritising areas for community and school based environmental grants
- Guiding decisions where to plant trees to offset the impacts of major road infrastructure projects
- Guiding planning policy on tree canopy and green space targets in housing developments
- Monitoring achievements of previous tree canopy planting, urban greening and urban heat mitigation strategies.

Councils:

- Prioritise street tree planting to target areas most impacted by urban heat as part of wider urban heat mitigation solutions
- Installation of cool surfaces such as light coloured roofing and permeable paving
- Water sensitive urban design feature installation
- Heat wave refuge initiatives.

Community:

- Data used to inform personal decisions regarding maintaining or increasing green space in home gardens and avoiding artificial turf, dark coloured roofing or paving
- Inform grant applications for community groups revegetation or rewilding projects.

FURTHER INFORMATION AND GUIDANCE

Green Adelaide

- Contact: Sarah White, Regional data officer / sarah.white4@sa.gov.au
- Urban Heat and tree canopy mapping project page

Department for Environment and Water

- Urban Heat and Tree Mapping viewer
- Urban Heat Viewer FAQ